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(54) Pipeline leak location.

(57) The position of a leak in a gas or liquid pipeline is accurately determined by measuring the amplitude of rarefactions propagated through the gas or liquid at least two monitoring points, one each upstream and downstream of the leak. The leak position is calculated using the formula

$$Y = \tfrac{1}{2}\left[\frac{\ln \gamma}{\alpha} + S\right]$$

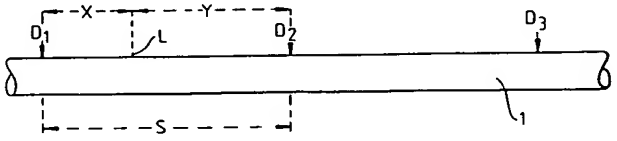
where

Y is the distance of the leak from one of the monitoring points;

S is the distance between two monitoring points, one on each side of the leak;

γ is the amplitude ratio of the rarefactions received by the two monitoring points, and

α is the exponential attenuation factor with distance for the propagation of the rarefaction in the fluid.



EP 0 042 212 A1

Pipeline leak location

THE PRESENT INVENTION relates to an improved method for detecting the position of a leak in a pipeline containing a fluid under pressure.

The use of pipelines, both on land and under the sea, to carry liquids and gases has increased appreciably in recent years and continues to increase. Transport by pipeline is convenient and more economical than other means of transportation and once laid, pipelines require little maintenance and generally can be used for long periods of time, measured in years, before major servicing is required. However an ever-present risk in the use of pipelines is that the line may rupture and allow an escape of gas or liquid.

There is therefore a need for an apparatus and method which will enable a pipeline operator to have both rapid warning of an escape of liquid or gas from the pipeline and an accurate indication of the location of the leak. United Kingdom Patent Specification No. 1,438,237 describes how a rapid escape of fluid from a pipeline causes decompression waves to travel within the pipeline fluid in both directions away from the leak site. These decompression waves, or rarefactions, can be detected by monitoring the dynamic pressure of the fluid. Furthermore, the Specification describes how the leak position can be located by measuring the difference in time of arrival of the decompression wave at detectors installed on either side of the leak.

We have now found that the position of a leak in a pipeline can be determined by a method which may be used either as an alternative to or complementarily to earlier known methods.

According to the present invention a method of determining the existence and location of a distantly occurring leak of fluid from a pipeline or pressure vessel carrying fluid under pressure comprises measuring the amplitude of the rarefactions propagated through the

fluid by the leak at at least two monitoring points, at least one point being upstream of the leak and at least one point being downstream of the leak, and calculating the position of the leak using the equation

$$Y = \tfrac{1}{2}\left[\frac{\ln \gamma}{\alpha} + S\right]$$

where Y is the distance of the leak from one of the monitoring points;

S is the distance between two monitoring points, one on each side of the leak;

γ is the amplitude ratio of the rarefactions received by the two monitoring points; and

α is the exponential attenuation factor with distance for the propagation of the rarefaction in the fluid.

In its simplest form, the method of the invention is used with only two monitoring points and this will usually be sufficient to determine accurately the location of the leak. However, if desired, additional monitoring points can be employed to provide confirmatory determinations of the leak position.

The equation given hereinbefore for determining the leak position is derived as follows. Referring to the accompanying schematic drawing, (Fig. 1) a section of a pressure vessel 1 is shown. At intervals along the length of the pressure vessel are positioned monitoring stations D_1, D_2, D_3 .....D_n.

Suppose a leak occurs from the pressure vessel 1 at the point marked L. Let the distance from the leak to the two monitoring stations D_1 and D_2 be X and Y respectively and let the distance between D_1 and D_2 be S.

The rarefaction is attenuated exponentially with distance. Thus the attenuation between the leak and station D_1 is $\exp^{-\alpha X}$. Similarly the attenuation between the leak and station D_2 is $\exp^{-\alpha Y}$, where α is the exponential attenuation factor. The exponential attenuation factor, α, varies for different fluids and

different pipeline characteristics but the factor is readily determinable for any given fluid and pipeline by simulation of a leak in the pipeline, as hereinafter described.

The amplitude ratio, γ of the two rarefactions received at D_1, D_2 is given by

$$\gamma = \frac{\exp^{-\alpha X}}{\exp^{-\alpha Y}} \quad (1)$$

or

$$\gamma = \exp^{-\alpha (X-Y)} \quad (2)$$

Taking logarithms to base e

$$\ln\gamma = -\alpha (X-Y) \text{ or } \frac{\ln\gamma}{\alpha} = Y-X \quad (3)$$

Also, $S = X+Y$ is the distance between D_1 and D_2 (4)

Adding (3) and (4)

$$\frac{\ln\gamma}{\alpha} + S = 2Y$$

The only unknown is Y, the distance from the leak to station D_2, which can therefore be calculated.

The amplitude of the rarefactions may be measured using any known suitable apparatus but the Applicants have found apparatus of the type described in UK Patents Nos. 1,374,797 and 1,438,237 to be particularly suitable.

Experiments to test the feasibility of the method of this invention were carried out in a spur line of an ethylene pipeline. The escape of ethylene through a leak in the pipeline was simulated by rapidly opening a valve in the 6" spur line for a few seconds.

A transient pressure wave leak detector was located some 10 miles from the leak. The detector was a micro-computer-based system in which the sensors are piezoelectric transducers which monitor the dynamic pressure of the ethylene.

The pressure pulse created by the leak travelled along the pipeline at the velocity of sound in ethylene

and arrived at the detector after about ½ minute. The pulse then travelled onto the end of the spur line (about a further mile distant) and was reflected back to the detector.

It was detected and then travelled back to the leak source which was close to the other end of the spur. The pulse was again reflected and travelled back to the receiver. Thus the detector received a series of the signals from the same leak, allowing the attenuation to be measured. Knowing the attenuation the position of any subsequent leak can be determined.

(In normal practice, of course, the pulse would continue along the pipe line and two monitoring stations located either side of the leak would be used).

It was found that the pressure pulse peak amplitude was linearly proportional to the leak area and, over the range measured, to line pressure. The average attenuation of the pressure pulse with distance was found, in this instance, to be 0.65 ± 0.05 dB/mile.

The effect of opening and closing the valve in the spur line to simulate the leak is illustrated in Figure 2 which is a plot of the dynamic pressure in the line with time.

The method of the present invention provides a novel way of determining accurately the position of the leak. The method can be used on its own or in conjunction with other methods, thereby providing confirmatory results. This is a particularly important consideration in dealing with leaks in difficultly accessible locations, for example underground or under-sea pipelines, where considerable expense is involved in reaching the leak. Accurate information on the leak position is essential to avoid unnecessary expense.

Claim

1. A method of determining the existence and location of a distantly occurring leak of fluid from a pipeline or pressure vessel carrying fluid under pressure which comprises measuring the amplitude of the rarefactions propagated through the fluid by the leak at at least two monitoring points, at least one point being upstream of the leak and at least one point being downstream of the leak, and calculating the position of the leak using the equation

$$Y = \tfrac{1}{2}\left[\frac{\ln \gamma}{\alpha} + S\right]$$

where Y is the distance of the leak from one of the monitoring points;

S is the distance between two monitoring points, one on each side of the leak;

γ is the amplitude ratio of the rarefactions received by the two monitoring points; and

α is the exponential attenuation factor with distance for the propagation of the rarefaction in the fluid.

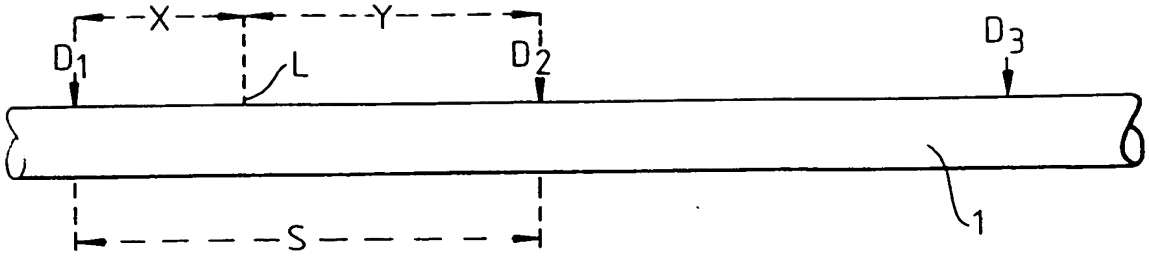

X
Y
D1
L
D2
D3
1
S

Fig . 1.

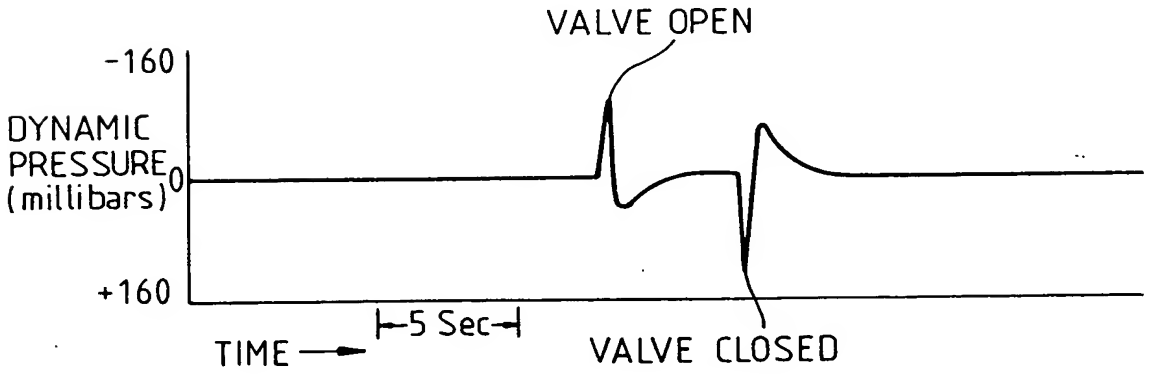

VALVE OPEN
-160
DYNAMIC
PRESSURE
(millibars)
0
+160
5 Sec
TIME
VALVE CLOSED

Fig. 2.

0,20

ЗАКЛЮЧЕНИЕ ЭКСПЕРТИЗЫ

Международная заявка № PCT/RU 2003/000375

V. Утверждение в соответствии со ст. 35(2) в отношении новизны, изобретательского уровня и промышленной применимости; ссылки и пояснения, подкрепляющие такое утверждение

1. Утверждение

Новизна (N)	Пункты	1-18	ДА
	Пункты		НЕТ
Изобретательский уровень(IS)	Пункты		ДА
		1-18	НЕТ
Промышленная применимость (IA)	Пункты	1-18	ДА
	Пункты		НЕТ

2. Ссылки и пояснения (правило 70.7), подкрепляющие такое утверждение:

Ссылки даны на следующие документы:

D1- EP 0025344 A1

D2- RU 98111122 A

D3- RU 2155905 C2

Формула изобретения отвечает критерию промышленная применимость

В качестве наиболее близкого аналога для заявленных объектов по п.п. 1-10 и 17-18 принято решение, известное из D1.

Из документа D1 (см. описание: с.5-11) известен трубопровод, а также известен способ контроля состояния трубопровода, в котором он снабжен выпуклой спиралью для контроля состояния стенки трубопровода электромагнитными излучениями, например, оптическим методом с использованием спирали в качестве волновода. Транспортный трубопровод представлен в комбинации с модулем контроля - волоконно-оптической спиралью (ВОС) и контролирующей системой, при этом модуль контроля произведит после вопроса – ответа вывод о состоянии стенки трубопровода. Контролирующая система периодически опрашивает модуль контроля ВОС, пропуская по нему электромагнитные излучения, например, оптические, чтобы определить, в каком месте поврежден трубопровод. Определение места повреждения трубопровода осуществляют по изменению оптических колебаний.

Отличия заявленной трубы по независимому п.1 заключаются в том, что винтовой шаг спирали выбран не больше длины критической трещины трубы. Это позволяет своевременно определять в трубопроводе опасные продольные трещины и другие дефекты.

Такой выбор винтового шага спирали известен из D2 (см. п.2 формулы).

Таким образом, объект по п.1 соответствует критерию новизны и не соответствует изобретательскому уровню.

В документе D2 также указано на наличие нескольких спиралей на трубе, однако, нет указаний на различное их направление. Можно предположить, что направления спиралей совпадают. Таким образом, зависимый п.2 соответствует критерию новизны и не соответствует изобретательскому уровню.

Международная заявка №
PCT/RU 2003/000375

ЗАКЛЮЧЕНИЕ ЭКСПЕРТИЗЫ

Дополнительный раздел
(Используется в случае недостатка места в любом предыдущем разделе)

Из D2 также известны спиральные поверхности в стенке трубопровода, которые формируют накаткой в виде канавки и заполняют их стеклом. Признаки стекловидная масса в описании заявленного изобретения по п.1 (см описание, стр.8) раскрыты как «твердое вещество, например, стекло». Таким образом, признаки п.3 известны из D2, а признаки п.4 – из D1.

Таким образом, зависимые п.3 и п.4 соответствуют критерию новизны и не соответствуют изобретательскому уровню.

Отличие способа по п.5 от известного из D1 способа заключается в том, что «винтовой шаг проводящей спирали выбирают не больше длины критической трещины трубы». Это позволяет своевременно определять в трубопроводе опасные продольные трещины и другие дефекты.

Указанные отличительные признаки известны из документа D2, где они проявляют те же свойства. Объект по п.5 соответствует критерию новизны и не соответствует изобретательскому уровню.

Признаки зависимых пунктов 6-10 также известны и очевидным образом следуют из документа D2.

Таким образом, зависимые п.п. 6-10 соответствуют критерию новизны и не соответствуют изобретательскому уровню.

В независимом п.11 совокупность признаков характеризует способ ремонта трубопровода.

Наиболее близким аналогом к заявленному способу является известный из D3 (см. описание: с.5, кол.1, строка 50 – кол.2. строка 50) способ ремонта металлических трубопроводов. заключающийся в определении с помощью физических методов и приборов (стресс-сканов, лазерных, рентгеновских и др.) напряжений на ремонтируемом участке в дефектной области трубопровода, расчете уровня снижения рабочего давления в трубопроводе в момент проведения ремонтных работ, очистке поверхности трубопровода, антикоррозионной обработке и устранении дефектов в стенке трубопровода.

Отличия заявленного способа по п.11 заявленной формулы состоят в том, что в трубопроводе образуют по крайней мере, одну спираль, винтовой шаг которой выбирают не больше длины критической трещины трубы, обследуют эту спираль для определения дефекта в стенке трубопровода, восстанавливают дефектную стенку теплом колебаний, пропускаемых проводящей спиралью в раскрытие трещины.

Указанные отличительные признаки обеспечивают «промышленную контролепригодность трубопровода», «своевременное определение в трубопроводе опасных продольных трещин и других дефектов» и «уменьшение трудоемкости ремонта повреждений стенки трубопровода».

Перечисленные выше отличительные признаки независимого п.11 известны из документа D2, где они проявляют те же, указанные выше свойства.

Признаки зависимых пунктов 12-16 формулы известны и очевидным образом следуют из документов D2, D1, как известны и проявляемые ими свойства.

Таким образом, объекты по п.п.11-16 соответствуют критерию новизны и не соответствуют изобретательскому уровню.

Отличие заявленного способа по п.17 от известного из D1 способа заключается в том, что устройство содержит последовательно соединенные блок питания, преобразователь напряжения в переменное, излучатель и оптоэлектронную пару. которая соединена с датчиком в виде волоконно-оптической линии и первым входом монитора, второй вход которого подключен к выходу преобразователя постоянного напряжения в переменное, расстояние между витками спирали волоконно-оптической линии выбрано не больше длины критической трещины.

ЗАКЛЮЧЕНИЕ ЭКСПЕРТИЗЫ

Международная заявка №
PCT/RU 2003/000375

Дополнительный раздел
(Используется в случае недостатка места в любом предыдущем разделе)

Данные отличительные признаки обеспечивают «промышленную контролепригодность трубопровода», «своевременное определение в трубопроводе опасных продольных трещин и других дефектов» и «уменьшение трудоемкости ремонта повреждений стенки трубопровода».

Отличительные признаки независимого п.17 формулы изобретения, их назначение и проявляемые ими свойства известны из документа D2. Отличительные признаки зависимого п.18 также известны из документа D2. Таким образом, п.п. 17, 18 соответствуют критерию новизны и не соответствуют изобретательскому уровню.

Таким образом, характеризующая заявленную группу изобретений совокупность признаков, изложенная в п.п.1-18 формулы изобретения отвечает критерию новизны и не соответствует изобретательскому уровню, поскольку заявленная группа изобретений явным образом следует из уровня техники.

Bibliography

OPINION OF THE EXAMINATION OF EXPERTS

International application No.
RST/RU 2003/000375

V. Approval in compliance with article 35(2) with respect to novelty, inventor's level and industrial applicability; references and explanations supporting such an approval

1. Approval

Novelty (N) Items 1-18 YES

Items NO

Inventor's level (IS) Items YES

Items 1-18 NO

Industrial applicability (IA) Items 1-18 YES

Items NO

2. References and explanations (rule 70.7) supporting this approval:

References are given for the following documents:

D1 – RP 0025344 A1

D2 – RU 98111122A

D3 – RU 2155905 C2

The claim of the invention complies with criterion industrial applicability

Solution known from D1 is taken as an analog which is the closest for the claimed objects according to pars. 1-10 and 17-18.

From document D1 (see description p. 5-11) a pipeline is known, and also a method of pipeline state control is known, in which it is fitted with a convex spiral to check up the state of pipeline wall with the aid of electromagnetic radiation, for example, by optic methods with the use of a spiral as a waveguide. Transportation pipeline is presented in combination with a control module – fiber-optical spiral (FOS) and a control system, in this case the control module, after a question–response, makes a conclusion of the state of a pipeline wall. The control system questions the control module (FOS) periodically by issuing electromagnetic radiation over it, e.g. optical ones, in order to determine in what point the pipelines is damaged. Determination of the point of pipeline damage is achieved by a change of optical vibrations.

The differences of the claimed pipe by the independent par. 1 lies in that the helical lead is selected to be not more than the length of a pipe critical crack. This makes it possible to opportunely determine hazardous longitudinal cracks and other defects in the pipe.

Such a choice of helical lead is known from D2 (see par. 2 of the Claims).

Thus, the object according to par. 1 complies with the criterion of novelty and does not

comply with the inventor's level.

Document D2 also indicates several spirals on a pipe, however, there no indication to their various directions. We may suppose that spiral directions coincide. Thus the dependent par. 2 complies with the criterion of novelty and does not comply with the inventor's level.

OPINION OF THE EXAMINATION OF EXPERTS

International application No.
RST/RU 2003/000375

Additional section
(It is used in the case of space shortage in any previous section

From D2 spiral surfaces in the pipeline wall are also known that are formed by knurling in the form of a groove and filled with glass. Features vitreous mass in the description of the claimed invention according to par. 1 (see description on p. 8) are disclosed as "solid substance, e.g. glass". Thus the features of par. 3 are known from D2 and features D4 – from D1.

Thus the dependent par. 3 and par. 4 comply with novelty criterion and do not comply with the criterion of inventor's level.

The difference of the feature according to par. 5 from the one known method D1 lies in that the "helical lead of the conductive spiral is selected to be not more than the length of pipe critical length". This makes it possible to opportunely determine dangerous longitudinal cracks and other defects in the pipeline.

The said distinctive features are known from document D2, where they manifest the same properties. The object according to par. 5 complies with the novelty criterion and does not comply with the inventor's level.

The features of dependent paragraphs 6 to 10 are also known, and they proceed in an obvious manner from document D2.

Thus dependent paragraphs 6 to 10 comply with the novelty criterion and do not comply with the inventor's criterion.

In the independent par. 11 the aggregate of features characterizes the method of pipeline repair.

A closest analog to the claimed method is a repair method for repairing metal pipelines known from D3 (see description: p. 4 column 1, line 50) lying in determining with the aid of physical methods and instruments (stress-scanners, laser, X-ray and other ones) stresses on a section under repair in the pipeline defective area, in calculating the working pressure value in the pipeline at the moment of repair work implementation, in cleaning of pipeline surface, corrosion-resistant treatment and eliminating the defects in the pipeline wall.

The differences of the claimed method according to par. 11 of the claim lies in that at least one spiral is formed in the pipeline, whose helical lead is selected to be not more than the length of pipe critical crack, this spiral is examined for determining a defect in the pipeline wall, the defective wall is recovered by the heat of vibrations put into the crack opening by the conductive spiral.

The said distinctive features ensure the "industrial controllability of a pipeline", "opportune determination hazardous longitudinal cracks and other defects" and "decrease of labor consumption in repairing a damaged pipeline wall".

The above-listed distinctive features of independent par. 11 are known from document D2, where they manifest the same aforesaid properties.

The features of dependent paragraphs 12-16 of the claims are known, and they apparently manifest the same aforesaid properties.

The features of dependent pars. 12-16 of the claim are known, and they obviously proceed from documents D2, D1 as well as the properties manifested by them are known.

Thus objects according to pars. 11 to 16 comply with novelty criterion and do not comply with the inventor's level.

The difference of the claimed methods according to par. 17 from a method known from D1 lies in that the device contains series-connected power unit, dc-to-ac voltage converter, radiator and optoelectronic couple which is connected with a sensor in the form of fiber-optic line and with the first monitor inlet, whose second inlet is connected to the outlet of permanent dc-to-ac voltage converter, the distance between the turns of the fiber-optic line spiral is selected not to exceed the critical crack length.

OPINION OF THE EXAMINATION OF EXPERTS

International application No.
RST/RU 2003/000375

Additional section
(It is used in the case of space shortage in any previous section

These distinctive features ensure "industrial controllability of the pipeline", "opportune detection of hazardous longitudinal cracks and other defects in the pipeline" and "decrease of labor intensity of the repair of pipeline wall injuries".

Distinctive features of independent par. 17 of the claims, their purpose and properties manifested by them are known from document D2. Distinctive features of dependent par. 18 are also known from document D2. Thus pars. 17, 18 comply with the novelty criterion and do not comply with the inventor's level.

Thus the totality of features characterized the claimed group of inventions and set forth in pars. 1 to 18 of the claims complies with the novelty criterion and does not comply with the inventor's level, since the claimed group of inventions apparently proceeds from the level of engineering.

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Корреспонденция в соответствии с Договором о патентной кооперации (PCT)
Наш № PCT/RU03/00375 от 24 сентября 2003 (24.09.2003) от ПОЛУЧАЮЩЕГО ВЕДОМСТВА
Исх. 9150-24.0903

PCT

СООБЩЕНИЕ ДЛЯ СЛУЧАЕВ, КОГДА УВЕДОМЛЕНИЯ ДРУГОЙ ФОРМЫ НЕ ПРИМЕНИМЫ

Кому:
115612, Москва, а/я 23,
А. Б. Соколову

№ дела заявителя: -	О необходимости ответа см. ниже параграф 1
Номер международной заявки: PCT/RU ~~01/00144~~ 03/00375	Дата международной подачи : 21 августа 2003 (21.08.2003)
Заявитель: ГУРОВ Александр Ефимович	

1. [X] ОТВЕТ ТРЕБУЕТСЯ в месячный срок с даты отправки
   [ ] ОТВЕТА НЕ ТРЕБУЕТСЯ, однако, см. ниже
   [ ] ЯВЛЯЕТСЯ ВАЖНЫМ УВЕДОМЛЕНИЕМ
   [X] ТОЛЬКО ДЛЯ ИНФОРМАЦИИ

2. ТЕКСТ СООБЩЕНИЯ:

В ответ на корреспонденцию, поступившую в Федеральный институт промышленной собственности 12 сентября 2003 (12.09.2003), сообщаю следующее.

Срок перехода на национальную фазу в указанные государства в соответствии со статьей 22 (1) Договора о патентной кооперации (PCT) с 01 апреля 2002 (01.04.2002) составляет 30 месяцев с даты приоритета международной заявки, и для вышеуказанной заявки PCT/RU03/00375 заканчивается 21 февраля 2005 (21.02.2005).

Однако, на настоящий момент для нескольких государств, а именно : BR, CH, FL, LU, NO, SE, SG, TZ, UG, CS и ZM, еще действует срок перехода на национальную фазу в 20 месяцев с даты приоритета международной заявки. Для этих государств срок перехода на национальную фазу для вышеуказанной заявки PCT/RU03/00375 заканчивается 21 апреля 2004 (21.04.2004). Кроме того, если заявитель в соответствии со статьей 31 PCT подает Требование на проведение международной предварительной экспертизы до истечения 19 месяцев с даты приоритета международной заявки (для заявки PCT/RU03/00375 - до 21 марта 2004 (21.03.2004) , то срок перехода на национальную фазу и в эти государства продлевается до 30 месяцев с даты приоритета международной заявки.

Наименование и адрес получающего ведомства:	Подпись уполномоченного лица:
Федеральный институт промышленной собственности Россия, 121858, Москва, Бережковская наб., 30-1 тел.(095) 240-58-88, факс (095) 243-33-37 телетайп 114818 ПОДАЧА	Н. Г. Удальцова

Форма PCT/RO/132 (июль 1992)

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1. ANSWER IS REQUIRED WITHIN THE MONTH PERIOD SINCE THE DATE OF DEPARTURE

ANSWER IS NOT REQUIRED, yet see below

IS AN IMPORTANT NOTICE

FOR INFORMATION ONLY

2. TEXT OF THE MESSAGE

In response to the correspondence that has come to the Federal Institute of industrial property on September 12, 2003 (12.09.2003), I herein inform of the following.

The period of transfer to the national phase in the said states in compliance with article 22 (1) of the Patent cooperation treaty (PCT) from April 1, 2002 (01.04.2002), is 30 months from the date of international application priority, and for the aforesaid application PCT/RU03/00375 it expires on February 21, 2005 (21.02.2005).

However, at the present moment for several states, namely, BR, CH, FL. LU, NO, SE, SG, TZ, UG, CS and ZM a period of transfer to the national phase which is 20 months from the date of international application priority, is still valid. For these states the period of transfer to the national phase for the said application PCT/RU03/00375 expires on April 21, 2004 (21.04.2004). In addition, if the applicant, in accordance with article 31 of PCT presents a Demand for carrying out an international preliminary examination before the expiry of 19 months from the date of international application priority (for application PCT/RU03/00375 – before March 21, 2004 (21.03.2004), the period of transfer to the national phase to these states as well is extended to 30 months from the international application priority date.

European Patent Office

EUROPEAN SEARCH REPORT

Application number
0042212
EP 81 30 2171

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	OIL & GAS JOURNAL, vol. 77, no. 48, November 26, 1979 (US) W.E. LAWSON: "How to detect breaks in pipelines automatically" pages 82-86 * the whole document * --	claim
E	WO - A - 80/01941 (KOMMUNALPROEKT) * abstract; figures * --	claim
E	WO - A - 80/01943 (KOMMUNALPROEKT) * abstract; figures * ------	claim

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

F 17 D 5/06
G 01 M 3/28

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

F 17 D
G 01 M

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	07-09-1981	VERELST

EPO Form 1503.1 06.78

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